AD NO. _____
DTC PROJECT NO. 8-CO-160-UXO-021
REPORT NO. ATC-9843

STANDARDIZED

UXO TECHNOLOGY DEMONSTRATION SITE

SCORING RECORD NO. 920

SITE LOCATION:
U.S. ARMY ABERDEEN PROVING GROUND

DEMONSTRATOR:
NAVAL RESEARCH LABORATORY (NRL)
CODE 6110
WASHINGTON, DC 20375

TECHNOLOGY TYPE/PLATFORM:
MTADS DISCRIMINATION/TOWED

AREAS COVERED:
BLIND GRID
INDIRECT FIRE

PREPARED BY:
U.S. ARMY ABERDEEN TEST CENTER
ABERDEEN PROVING GROUND, MD 21005-5059

NOVEMBER 2008

Prepared for:
U.S. ARMY ENVIRONMENTAL COMMAND
ABERDEEN PROVING GROUND, MD 21010-5401

U.S. ARMY DEVELOPMENTAL TEST COMMAND
ABERDEEN PROVING GROUND, MD 21005-5055

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14. ABSTRACT

This scoring record documents the efforts of NRL. to detect and discriminate inert unexploded ordnance (UXO) utilizing the YPG Standardized UXO Technology Demonstration Site blind grid. This scoring record was coordinated by J. Stephen McClung and the Standardized UXO Technology Demonstration Site Scoring Committee. Organizations on the committee include the U.S. Army Corps of Engineers, the Environmental Security Technology Certification Program, the Strategic Environmental Research and Development Program, the Institute for Defense Analysis, the U.S. Army Environmental Command, and the U.S. Army Aberdeen Test Center.

15. SUBJECT TERMS
None.

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SECTION 1. GENERAL INFORMATION

1.1 BACKGROUND

Technologies under development for the detection and discrimination of military munitions (MM) (i.e. unexploded ordnance {UXO} and discarded military munitions {DMM}) require testing so that performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland, and U.S. Army Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in munitions and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multiagency program spearheaded by the U.S. Army Environmental Command (USAEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

1.2 SCORING OBJECTIVES

The objective in the Standardized UXO Technology Demonstration Site Program is to evaluate the detection and discrimination capabilities of a given technology under various field and soil conditions. Inert munitions and clutter items are positioned in various orientations and depths in the ground.

The evaluation objectives are as follows:

a. To determine detection and discrimination effectiveness under realistic scenarios with various targets, geology, clutter, density, topography, and vegetation.

b. To determine cost, time, and workforce requirements to operate the technology.

c. To determine demonstrator's ability to analyze survey data in a timely manner and provide prioritized Target Lists with associated confidence levels.

d. To provide independent site management to enable the collection of high quality, ground-truth, geo-referenced data for post-demonstration analysis.

e. This scoring record is being scored under methodology initiated after 1 August 2008.

1.2.1 Scoring Methodology

a. The scoring of the demonstrator's performance is conducted in two stages: response stage and discrimination stage. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of clutter detection (P_{cd}) or the probability of false positive (P_{fp}). Those that do not correspond to any known item are termed background alarms. The background alarms are addressed as either probability of background alarm (P_{ba}) or background alarm rate (BAR).

b. The response stage scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate munitions from other anomaly sources. For the blind grid response stage, the demonstrator provides a target response from each and every grid square along with a threshold below which target responses are deemed insufficient to warrant further investigation. This list is generated with minimal processing and, since a value is provided for every grid square, includes amplitudes both above and below the system noise level. For the open field, the demonstrator provides a list of all anomalies deemed to exceed a demonstrator selected target detection threshold. An item (either munition or clutter) is counted as detected if a demonstrator indicates an anomaly within a specified distance (Halo Radius {R_{halo}}) of a ground truth item.

c. The discrimination stage evaluates the demonstrator's ability to correctly identify munitions as such and to reject clutter. For the blind grid discrimination stage, the demonstrator provides the output of the discrimination stage processing for each grid square. For the open field, the demonstrator provides the output of the discrimination stage processing for each anomaly reported in the response stage. The values in these lists are prioritized based on the demonstrator's determination that a location is likely to contain munitions. Thus, higher output values are indicative of higher confidence that a munitions item is present at the specified location. For digital signal processing, priority ranking is based on algorithm output. For other discrimination approaches, priority ranking may be based on rule sets or human judgment. The demonstrator also specifies the threshold in the prioritized ranking that provides optimum performance, (i.e. that is expected to retain all detected munitions and reject the maximum amount of clutter).

d. The demonstrator is also scored on efficiency and rejection ratios, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of munitions detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-munitions items. Efficiency measures the fraction of detected munitions retained after discrimination, while the rejection ratio measures the fraction of false alarms rejected. Both measures are defined relative to the maximum number of munitions detectable by the sensor and its accompanying clutter detection/false positive rate or BAR.

e. Based on configuration of the ground truth (GT) at the standardized sites and the defined scoring methodology, in some cases, there exists the possibility of having anomalies within overlapping halos and/or multiple anomalies within halos. In these cases, the following scoring logic is implemented:

(1) In situations where multiple anomalies exist within a single R_{halo}, the anomaly with the strongest response or highest ranking will be assigned to that particular GT item. If the responses or rankings are equal, then the anomaly closest to the GT item will be assigned to the GT item. Remaining anomalies are retained and scored until all matching is complete.

(2) Anomalies located within any R_{halo} that do not get associated with a particular GT item are excess alarms and will be disregarded.

f. In some cases, groups of closely spaced munitions have overlapping halos. The following scoring logic is implemented (fig. A-1 through A-9):

(1) Overall site scores (i.e., P_d) will consider only isolated munitions and clutter items.

(2) GT items that have overlapping halos (both munitions and clutter) will form a group and groups may form chains.

(3) Groups will have a complex halos composed of the composite halos of all its GT items.

(4) Groups will have three scoring factors: groups found groups identified and group coverage. Scores will be based on 1:1 matches of anomalies and GT.

(a) Groups Found (Found): the number of groups that have one or more GT items matched divided by the total number of groups. Demonstrators will be credited with detecting a group if any item within the group is matched to an anomaly in their lists.

(b) Groups Identified (ID): the number of groups that have two or more GT items matched divided by the total number of groups. Demonstrators will be credited with identifying that a group is present if multiple items within the composite halo are matched to anomalies in their lists.

(c) Group Coverage (Coverage): the number of GT items matched within groups divided by the total number of GT items within groups. This metric measures the demonstrator accuracy in determining the number of anomalies within a group. If five items are present and only two anomalies are matched, the demonstrator will score 0.4. If all five are matched, the demonstrator will score 1.0.

(5) Location error will not be reported for groups.

(6) Demonstrators will not be asked to call out groups in their scoring submissions. If multiple anomalies are indicated in a small area, the demonstrator will report all individual anomalies.

(7) Excess alarms within a halo will be disregarded.

g. All scoring factors are generated utilizing the Standardized UXO Probability and Plot Program, version 4.

1.2.2 Scoring Factors

Factors to be measured and evaluated as part of this demonstration include:

a. Response stage ROC curves:

(1) Probability of detection (P_d^{res}).

(2) Probability of clutter detection (P_{cd}).

(3) Background alarm rate (BAR^{res}) or probability of background alarm (P_{ba}^{res}).

b. Discrimination stage ROC curves:

(1) Probability of detection (P_d^{disc}).

(2) Probability of false positive (P_{fp}).

(3) Background alarm rate (BAR^{disc}) or probability of background alarm (P_{ba}^{disc}).

c. Metrics:

(1) Efficiency (E).

(2) False positive rejection rate (R_{fp}).

(3) Background alarm rejection rate (R_{ba}).

d. Other:

(1) Probability of detection by size, depth, and density.

(2) Classification by type (i.e., 20-, 40-, 105mm, etc.).

(3) Location accuracy for single munitions.

(4) Equipment setup, calibration time and corresponding man-hour requirements.

(5) Survey time and corresponding worker-hour requirements.

(6) Reacquisition/resurvey time and worker-hour requirements (if any).

(7) Downtime due to system malfunctions and maintenance requirements.

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SECTION 2. DEMONSTRATION

2.1 DEMONSTRATOR INFORMATION

2.1.1 Demonstrator Point of Contact (POC) and Address

POC: Mr. Herb Nelson
202-767-3686

Address: NRL
Code 6110
Washington, DC 20375

2.1.2 System Description (provided by demonstrator)

a. The MTADS Discrimination array consists of 25 individual EMI sensors arranged in a 5 x 5 array. The center-to-center distance is 40 cm yielding a 2 m x 2 m array is the position of the three GPS antennae that are used to determine the location and orientation of the array for each cued measurement.

b. Each individual sensor includes a 35-cm transmit coil and an inner, 25-cm receive coil. Decay data are collected with a 500 kHz sample rate until 25 ms after turn off of the excitation pulse. These raw decay measurements are grouped into 115 logarithmically-spaced "gates" whose center times range from 42 μs to 24.35 ms with 5% widths.

c. Application of this technology is straightforward. A list of target positions is developed from a survey by some geophysical instrument; in the case of this demonstration, the earlier survey by the MTADS magnetometer array. This target file, containing the target location and some estimate of target depth, is transferred to the system control program which uses the information from the three GPS antennae to guide the operator to position the array over each target in turn. When positioned over the target, we step through the array sensors sequentially, just as in the characterization measurements discussed in the preceding section, and collect decay from all twenty-five receive coils for each excitation. These data are then inverted for target location and characteristics. At the end of the EMI data collection, a few seconds of platform position and orientation data are collected to be used to translate the inverted target position, which is, of course, relative to the array, to absolute position and orientation.

d. Support equipment required: Overnight storage for the vehicle and array protected from the elements and access to electrical power for battery charging is required. To avoid having to decouple the array from the trailer each evening, we propose to rent a storage container. NRL will need permission to place this container near the site. Storage space for GPS gear and workspace for the data quality control analyst can be located in the data trailer on the site.

Frequency and radio utilization: We are licensed for the following frequencies for GPS corrections:

461.0250 MHz	462.1250 MHz	464.5000 MHz	464.6250 MHz	464.7250 MHz
461.0750 MHz	462.3750 MHz	464.5500 MHz	464.6500 MHz	464.7500 MHz
461.1000 MHz	462.4000 MHz	464.6000 MHz	464.7000 MHz	

Access to one of these frequencies is required. NRL is currently using 464.6250 MHz but it is no problem to change to any of the licensed frequencies.

Figure 1. Demonstrator's system, MTADS/towed.

2.1.3 Data Processing Description (provided by demonstrator)

Target selection criteria: Targets for this demonstration will be chosen from the target list developed after the MTADS magnetometer array survey of the site to be performed in May 2008. Details of data handling and target detection algorithms are contained in the demonstration plan for that survey.

Parameter estimation:

a. Which characteristics will be extracted from each detected item and input to the discrimination algorithm (e.g. depth, size, polarizability coefficients, fit quality, etc)? Principal axis polarizabilities and fit quality.

b. Why have these characteristics been chosen and not others (e.g. empirical evidence of their ability to help discriminate, inclusion in a theoretical tradition, etc)? Testing experience with this technology indicates they are best characteristics for discrimination.

c. How are these characteristics estimated (e.g. least-mean-squares fit to a dipole model, etc), include the equations that are used for parameter estimation? Array data are least-squares fit to standard dipole response model for voltage in receive coil

$$V(t) = \mu_0 n_R n_T I_0 \mathbf{C}_R \cdot \mathbf{C}_T \mathbf{B}(t)$$

Where I_0 is transmit current, n_R and n_T are number of turns in transmit and receive coils, $\mathbf{C}_R$ and $\mathbf{C}_T$ are transmit and receive coil response functions calculated from the coil geometry using Biot-Savart law, and $\mathbf{B}$ is the polarizability tensor. The principal axis polarizabilities are the eigenvalues of $\mathbf{B}$, and fit quality is the squared correlation coefficient between the data and the model fit.

d. What tunable parameters (if any) are used in the characterization process? (e.g. thresholds on background noise, etc)? Polarizabilities for expected ordnance items determined from training data.

Classification:

a. What algorithm is used for discrimination (e.g. multi-layer perception, support vector machine, etc)? Generalized Likelihood.

b. Why is this algorithm used and not others? It is appropriate for our procedure which compares fit quality using previously determined UXO polarizabilities with unconstrained fit quality and was proven effective in the Discrimination Study Pilot Program.

c. Which parameters are considered as possible inputs to the algorithm? Constrained and unconstrained fit qualities.

d. What are the outputs of the algorithm (probabilities, confidence levels)? Closeness of measured response to UXO response.

e. How is the threshold set to decide where the munitions/non-munitions line lies in the discrimination process? Training data on UXO and clutter acquired in testing at our Blossom Point facility.

Training:

a. Which tunable parameters have final values that are optimized over a training set of data and which have values that are set according to geophysical knowledge (i.e. intuition, experience, common sense)? Ratio of UXO-constrained fit quality to unconstrained fit quality is optimized over a training set of data.

(1) For those tunable parameters with final values set according to geophysical knowledge:

(a) What is the reasoning behind choosing these particular values? N/A

(b) Why were the final values not optimized over a training set of data? N/A

(2) For those tunable parameters with final values optimized over the training set data:

(a) What training data is used (e.g. all data, a randomly chosen portion of data, etc)? All training data on UXO and clutter acquired in testing at our Blossom Point facility.

(b) What error metric is minimized during training (e.g. mean squared error, etc)? Bhattacharyya distance

(c) What learning rule is used during training (e.g. gradient descent, etc)? N/A

(d) What criterion is used to stop training (e.g. number of iterations exceeds threshold, good generalization over validation set of data, etc)? Limits of training data.

(e) Are all tunable parameters optimized at once or in sequence ("in sequence" = parameters 1 is held constant at some common sense values while parameter 2 is optimized, and then parameter 2 is held constant at its optimized value while parameter 1 is optimized)? All at once

b. What are the final values of all tunable parameters for the characterization process? Best threshold setting.

2.1.4 Data Submission Format

Data were submitted for scoring in accordance with data submission protocols outlined on the USAEC Web site www.uxotestsites.org. These submitted data are not included in this report in order to protect GT information.

2.1.5 Demonstrator Quality Assurance (QA) and Quality Control (QC) (provided by demonstrator)

QC: There are two items that need to be checked daily to ensure adequate system performance. They are: individual sensor response and reliability of GPS positions. Before beginning survey work each day, the performance of each of the sensors in the array is measured (after a ten to fifteen minute warm-up) by presenting a standard target to each sensor in turn. The resulting signals are checked against standard values.

Our data acquisition system gives the vehicle operator a continuous reading of the quality of the GPS fix. Our standard procedure is to only take data with a GPS fix quality of three (RTK fixed) or two (RTK float) and a PDOP (precision dilution of precision) of four or less. Before arriving at the site each day, we use standard GPS planning software to calculate the number of satellites that will be visible to the receivers and the PDOP achievable minute-by-minute throughout the day. This allows us to plan on short breaks during periods of poor satellite availability and keeps us from inadvertently taking data that will have to be discarded later. Another important feature of this GPS planning is the ability to take into account areas of restricted sky view (such as along the tree line at one edge of the APG site). In our experience, there is usually a brief period each day, on the order of 20 to 30 minutes, when good fixes can be obtained in even the most difficult environments. With planning, the system can be poised by the tree line ready to take data when the appropriate satellite alignment occurs.

QA: At the end of each one-hour survey session, all survey data is transferred to the field data analyst for preliminary data quality checks. This process involves plotting the actual survey path as logged in the GPS files (color-coded by GPS fix quality) to ensure that GPS data of sufficient quality was obtained during the survey. Following this, the individual sensor files are examined for completeness and consistency. It is at this stage that any sensor malfunctions, drifts, etc. are flagged and reported to the field crew for correction. The final task for the field analyst is to calculate a position for each sensor reading and apply it to the reading. The mapped data files are then ready for analysis either in the field, or at a later time.

2.1.6 Additional Records

The following record(s) by this vendor can be accessed via the Internet as MicroSoft Word documents at www.uxotestsites.org.

2.1.7 Additional Survey Information

On 7 May 2008, NRL first surveyed the site using their MTADS magnetometer array to first acquire the anomalies that were later reacquired during the 16 through 23 June 2008 survey of the site using the above described MTADS Discrimination towed array (an EMI array). Data analyzed and reported in section 4 is a combination of both surveys. The response stage results reported are from the MTADS magnetometer array data and the discrimination stage results are from the MTADS Discrimination towed array. Times reported in section 3 cover both the May and June surveys of the site.

2.2 APG SITE INFORMATION

2.2.1 Location

The APG Standardized Test Site is located within a secured range area of the Aberdeen Area. The Aberdeen Area of APG is located approximately 30 miles northeast of Baltimore at the northern end of the Chesapeake Bay. The Standardized Test Site encompasses 17 acres of upland and lowland flats, woods, and wetlands.

2.2.2 Soil Type

According to the soils survey conducted for the entire area of APG in 1998, the test site consists primarily of Elkton Series type soil (ref 2). The Elkton Series consist of very deep, slowly permeable, poorly drained soils. These soils formed in silty aeolin sediments and the underlying loamy alluvial and marine sediments. They are on upland and lowland flats and in depressions of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

ERDC conducted a site-specific analysis in May 2002 (ref 3). The results basically matched the soil survey mentioned above. Seventy percent of the samples taken were classified as silty loam. The majority (77 percent) of the soil samples had a measured water content between 15 and 30 percent with the water content decreasing slightly with depth.

For more details concerning the soil properties at the APG test site, go to www.uxotestsites.org on the Web to view the entire soils description report.

2.2.3 Test Areas

A description of the test site areas at APG is presented in Table 1. A test site layout is shown in Figure 2.

TABLE 1. TEST SITE AREAS

Area	Description
Calibration lanes	Contains 14 standard munitions items buried in six positions, with representation of clutter, at various angles and depths to allow demonstrators to calibrate their equipment.
Blind grid	Contains 400 grid cells in a 0.5-acre site. The center of each grid cell contains either munitions, clutter, or nothing.
Open field	A 10-acre site composed of generally open and flat terrain with minimal clutter and minor navigational obstacles. Vegetation height varies from 15 to 25 cm. This area is subdivided into four subareas (legacy, direct fire, indirect fire, and challenge).
	• *Open field (legacy)* The legacy subarea contains the same wide variety of randomly-placed munitions that were present in the open field prior to the January 2008 general reconfiguration of the site.
	• *Open field (direct fire)* The direct fire subarea contains only three munition types that could be typically found at an impact area of a direct fire weapons range. Munitions and clutter are placed in a pattern typical for these munitions.
	• *Open field (indirect fire)* The indirect fire subarea contains only three munition types that could be typically found at an impact area of an indirect fire weapons range. Munitions and clutter are placed in a pattern typical for these munitions.
	• *Open field (challenge)* The challenge subarea is easily reconfigurable used to meet the specific needs and requirements of the demonstrator or the program sponsor. Any results from this area will not be reported in the standardized scoring record.
Woods	1.34-acre area consisting of cleared woods (tree removal with only stumps remaining), partially cleared woods (including all underbrush and fallen trees), and virgin woods (i.e., woods in natural state with all trees, underbrush, and fallen trees left in place).
Moguls	1.30-acre area consisting of two areas (the rectangular or driving portion of the course and the triangular section with more difficult, nondrivable terrain). A series of craters (as deep as 0.91 m) and mounds (as high as 0.91 m) encompass this section.

2.2.4 STANDARD AND NONSTANDARD INERT MUNITIONS TARGETS

The standard and nonstandard munitions items emplaced in the test areas are presented in Table 2. Standardized targets are members of a set of specific munitions items that have identical properties to all other items in the set (caliber, configuration, size, weight, aspect ratio, material, filler, magnetic remanence, and nomenclature). Nonstandard targets are inert munitions items having properties that differ from those in the set of standardized items.

TABLE 2. INERT MUNITIONS TARGETS

Item	Munition Type	Calibration Lanes	Blind Grid	Open Field Direct Fire	Open field Indirect Fire	Open Field Legacy	Moguls	Woods
20-mm Projectile M55	S	X				X	X	X
25-mm Projectile M794	S	X	X	X				
37-mm Projectile M47	S	X	X	X				
40-mm Projectile MKII Bodies	S	X				X	X	X
BDU-28 Submunition	S	X				X	X	X
BLU-26 Submunition	S	X				X	X	X
M42 Submunition	S	X				X	X	X
57-mm Projectile APC M86	S	X				X	X	X
60-mm Mortar M49A3	S	X	X		X			
2.75-inch Rocket M230	S	X				X	X	X
81-mm Mortar M374	S	X	X		X	X	X	X
105-mm HEAT Rounds M456	S					X	X	X
105-mm HEAT Round M490	S	X	X	X				
105-mm Projectile M60	S	X	X		X	X	X	X
155-mm Projectile M483A1	S	X				X	X	X
20-mm Projectile M55	NS					X	X	X
20-mm Projectile M97	NS					X	X	X
40-mm Projectile M813	NS					X	X	X
60-mm Mortar (JPG)	NS					X	X	X
60-mm Mortar M49	NS					X	X	X
2.75-inch Rocket M230	NS					X	X	X
2.75-inch Rocket XM229	NS					X	X	X
81-mm Mortar (JPG)	NS					X	X	X
81-mm Mortar M374	NS					X	X	X
105-mm Projectile M60	NS					X	X	X
155-mm Projectile M483A	NS					X	X	X

S = Standard munition
NS = Nonstandard munition
JPG = Jefferson Proving Ground
HEAT = high-explosive antitank

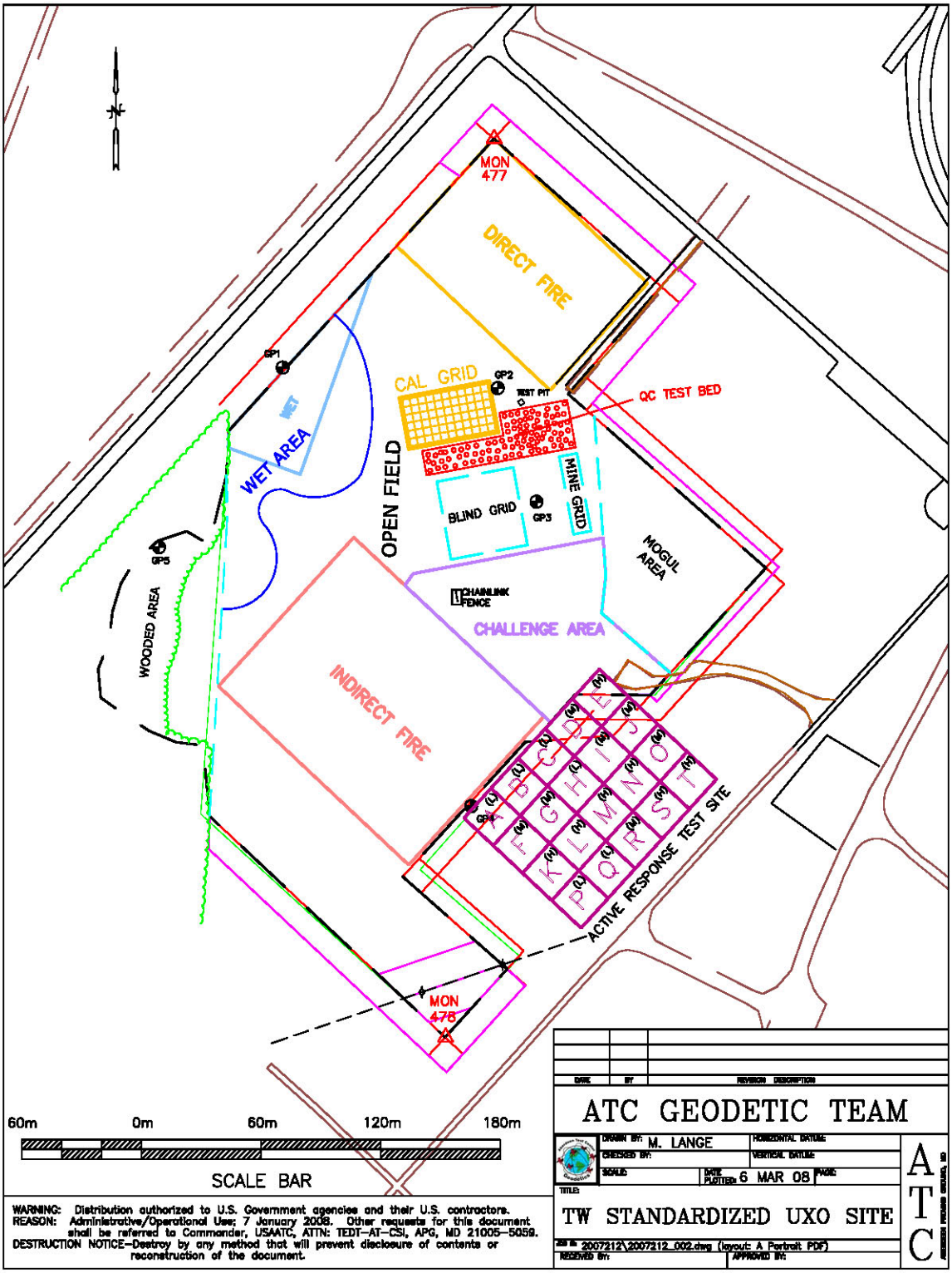

Figure 2. Test site layout.

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SECTION 3. FIELD DATA

3.1 DATE OF FIELD ACTIVITIES (7 May, 16 through 20, and 23 June 2008)

3.2 AREAS TESTED/NUMBER OF HOURS

Areas tested and total number of hours operated at each site are presented in Table 3.

TABLE 3. AREAS TESTED AND NUMBER OF HOURS

Area	Number of Hours
Calibration lanes	4.80
Blind grid	10.05
Open field	39.96
Woods	Not covered
Mogul	Not covered

Note: Table 3 represents the total time spent in each area.

3.3 TEST CONDITIONS

3.3.1 Weather Conditions

An APG weather station located approximately 1 mile west of the test site was used to record average temperature and precipitation on a half hour basis for each day of operation. The temperatures presented in Table 4 represent the average temperature during field operations from 0700 to 1700 hours, while precipitation data represents a daily total amount of rainfall. Hourly weather logs used to generate this summary are provided in Appendix B.

TABLE 4. TEMPERATURE/PRECIPITATION DATA SUMMARY

Date, 2008	Average Temperature, ^{o}F	Total Daily Precipitation, in.
7 May	73.6	0.00
16 June	79.7	0.01
17 June	73.3	0.00
18 June	72.0	0.00
19 June	70.5	0.00
20 June	76.1	0.00
23 June	78.5	0.02

3.3.2 Field Conditions

NRL surveyed the APG site early May and mid June. The weather was warm and the field was wet due to rain prior to testing.

3.3.3 Soil Moisture

Three soil probes were placed at various locations within the site to capture soil moisture data: blind grid, calibration, open field, and wooded areas. Measurements were collected in percent moisture and were taken twice daily (morning and afternoon) from five different soil depths (1 to 6 in., 6 to 12 in., 12 to 24 in., 24 to 36 in., and 36 to 48 in.) from each probe. Soil moisture logs are included in Appendix C.

3.4 FIELD ACTIVITIES

3.4.1 Setup/Mobilization

These activities included initial mobilization and daily equipment preparation and breakdown. A four-person crew took 50 minutes to perform the initial setup and mobilization. There were 3 hours and 5 minutes of daily equipment preparation, and end of the day equipment breakdown lasted 1 hour and 35 minutes.

3.4.2 Calibration

NRL spent a total of 4 hours and 48 minutes in the calibration lanes, of which 3 hours and 13 minutes was spent collecting data. Several other calibration exercises took place outside the calibration grid totaling 15 minutes in the blind grid and 55 minutes in the open field.

3.4.3 Downtime Occasions

Occasions of downtime are grouped into five categories: equipment/data checks or equipment maintenance, equipment failure and repair, weather, demonstration site issues, or breaks/lunch. All downtime is included for the purposes of calculating labor requirements (section 5) except for downtime due to demonstration site issues. Demonstration site issues, while noted in the daily log, are considered nonchargeable downtime for the purposes of calculating labor costs and are not discussed. Breaks and lunches are discussed in this section and billed to the total site survey area.

3.4.3.1 Equipment/data checks, maintenance. Equipment data checks and maintenance activities accounted for 5 hours and 5 minutes of site usage time. These activities included changing out batteries and performing routine data checks to ensure the data were being properly recorded/collected. NRL spent an additional 10 minutes for breaks and lunches.

3.4.3.2 Equipment failure or repair. 60 minutes was needed to resolve equipment failures that occurred while surveying. Three times NRL had to stop for a faulty satellite connection, and. NRL also got their vehicle stuck causing a ten minute delay.

3.4.3.3 Weather. No weather delays occurred during the survey.

3.4.4 Data Collection

TABLE 5. TOTAL TIME NRL SPENT PER AREA

AREA	Time, hr/min
Blind grid	10 hours/3minutes
Open field	39 hours/58 minutes
Legacy	Not reported
Direct fire	Not reported
Indirect fire	32 hours/30 minutes
Challenge	Not covered
Wooded	Not covered
Moguls	Not covered

Note: Table 5 represents the total time spent in each area collecting data.

3.4.5 Demobilization

The NRL survey crew went on to conduct a full demonstration of the site. Therefore, demobilization did not occur until 7 May and 23 June 2008. On those days, it took the crew 3 hours and 10 minutes to break down and pack up their equipment.

3.5 PROCESSING TIME

NRL submitted the raw data from the demonstration activities on the last day of the demonstration, as required. The scoring submittal data was provided 20 August 2008.

3.6 DEMONSTRATOR'S FIELD PERSONNEL

Herb Nelson, NRL
Dan Steinhurst, NOVA Research, Inc.
Glenn Harbaugh, NOVA Research, Inc.
Tom Bell, SAIC Inc.
Jim Kingdon, SAIC Inc.

3.7 DEMONSTRATOR'S FIELD SURVEYING METHOD

NRL surveyed the area on a point to point basis. Earlier points were determined with a Magnetometer and were further evaluated with the MTAD EMI array.

3.8 SUMMARY OF DAILY LOGS

Daily logs capture all field activities during this demonstration and are located in Appendix D. Activities pertinent to this specific demonstration are indicated in highlighted text.

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SECTION 4. TECHNICAL PERFORMANCE RESULTS

4.1 ROC CURVES USING ALL MUNITIONS CATEGORIES

The probability of detection for the response stage (P_d^{res}) and the discrimination stage (P_d^{disc}) versus their respective probability of clutter detection or probability of false positive within each area are shown in Figures 3 through 8. The probabilities plotted against their respective background alarm rate within each area are shown in Figures 9 through 14. Both figures use horizontal lines to illustrate the performance of the demonstrator at two demonstrator-specified points: at the system noise level for the response stage, representing the point below which targets are not considered detectable, and at the demonstrator's recommended threshold level for the discrimination stage, defining the subset of targets the demonstrator would recommend digging based on discrimination.

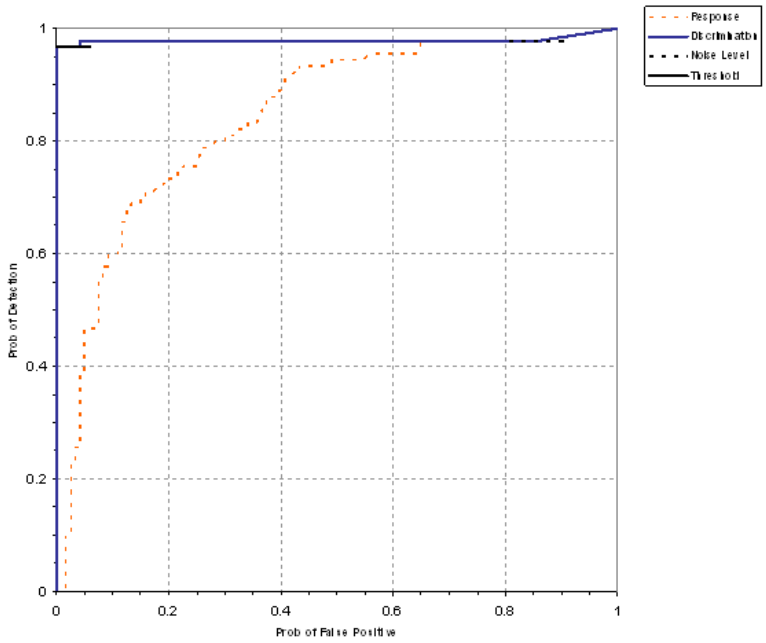

Figure 3. MTADS/towed blind grid probability of detection for response and discrimination stages versus their respective probability of false positive.

Not reported

Figure 4. MTADS/towed open field (direct-fire) probability of detection for response and discrimination stages versus their respective probability of false positive.

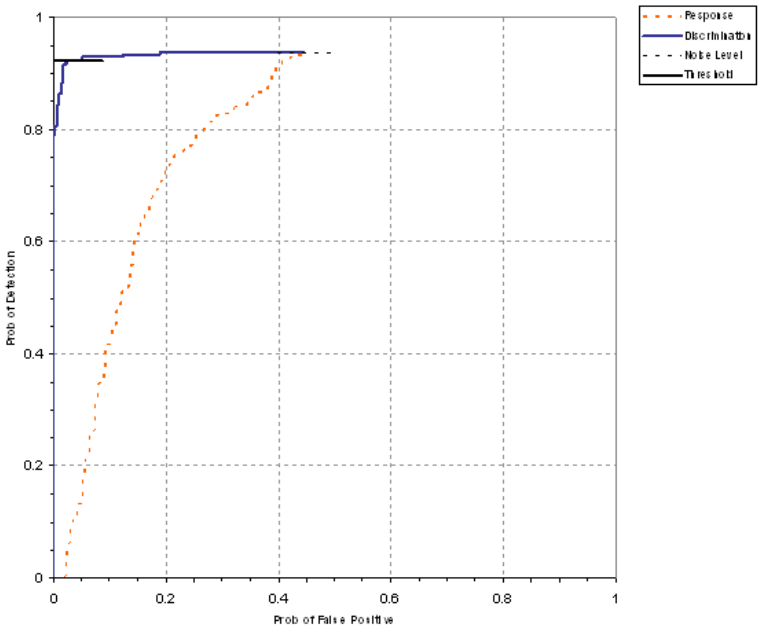

Figure 5. MTADS/towed open field (indirect-fire) probability of detection for response and discrimination stages versus their respective probability of false positive.

Not reported

Figure 6. MTADS/towed open field (legacy) probability of detection for response and discrimination stages versus their respective probability of false positive.

Not covered

Figure 7. MTADS/towed wooded probability of detection for response and discrimination stages versus their respective probability of false positive.

Not covered

Figure 8. MTADS/towed mogul probability of detection for response and discrimination stages versus their respective probability of false positive.

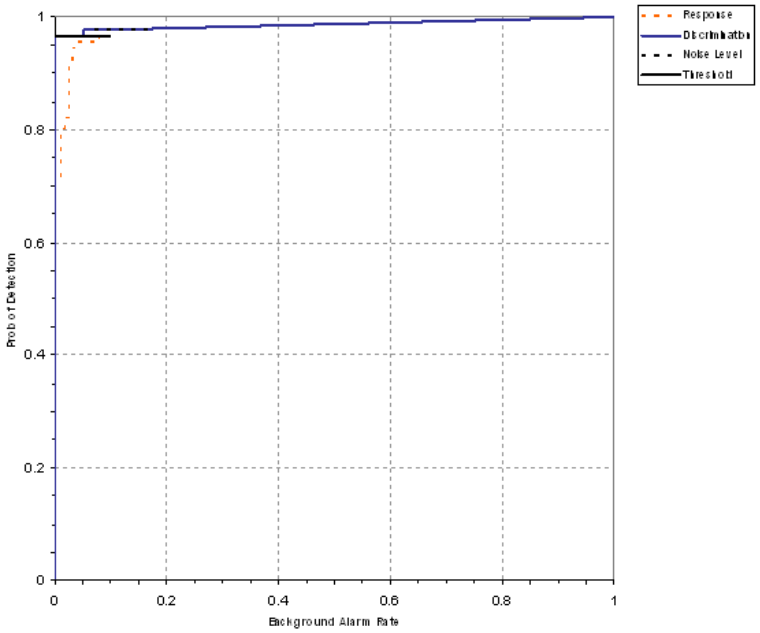

Figure 9. MTADS/towed blind grid probability of detection for response and discrimination stages versus their respective probability of background alarm.

Not reported

Figure 10. MTADS/towed open field (direct fire) probability of detection for response and discrimination stages versus their respective background alarm rate.

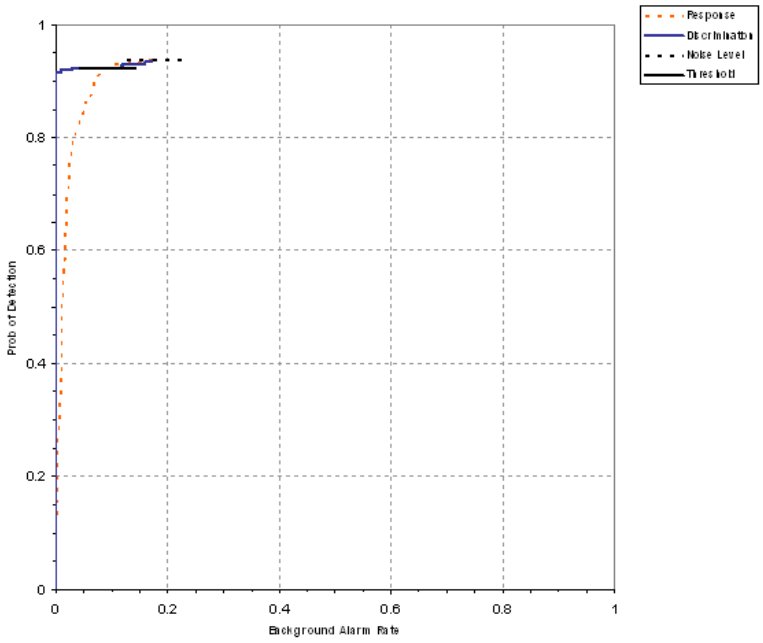

Figure 11. MTADS/towed open field (indirect fire) probability of detection for response and discrimination stages versus their respective background alarm rate.

Not reported

Figure 12. MTADS/towed open field (legacy) probability of detection for response and discrimination stages versus their respective background alarm rate.

Not covered

Figure 13. MTADS/towed wooded probability of detection for response and discrimination stages versus their respective background alarm rate.

Not covered

Figure 14. MTADS/towed mogul probability of detection for response and discrimination stages versus their respective background alarm rate.

4.2 PERFORMANCE SUMMARIES

Results for each of the testing areas are presented in Tables 6 (for labor requirements, see section 5). The response stage results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the discrimination stage are derived from the demonstrator's recommended threshold for optimizing munitions related cleanup by minimizing false alarm digs and maximizing munitions recovery. The lower and upper 90 percent confidence limits on P_d, P_{cd}, and P_{fp} were calculated assuming that the number of detections and false positives are binomially distributed random variables. All results in Table 6a through 6f have been rounded to protect the GT. However, lower confidence limits were calculated using actual results.

TABLE 6a. BLIND GRID TEST AREA RESULTS

Response Stage					**Discrimination Stage**			
Munitions[a] Scores	***P_d^{res}: by type***				***P_d^{disc}: by type***			
	All Types	**105-mm**	**81/60-mm**	**37/25-mm**	**All Types**	**105-mm**	**81/60-mm**	**37/25-mm**
	0.99	1.00	1.00	1.00	0.99	0.98	1.00	1.00
	0.98	0.97	0.97	1.00	0.97	0.93	0.97	1.00
	0.94	0.88	0.88	0.93	0.93	0.83	0.88	0.93
By Depth[b]								
0 to 4D	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4D to 8D	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8D to 12D	0.78	0.83	0.00	1.00	0.67	0.67	0.00	1.00
Clutter Scores	***P_{cd}***				***P_{fp}***			
By Mass								
By Depth[b]	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 10 kg**	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 10 kg**
All Depth	0.90				0.03			
	0.86	0.79	0.90	1.00	0.01	0.02	0.00	0.00
	0.81				0.00			
0 to 0.15 m	0.86	0.79	0.91	1.00	0.01	0.02	0.00	0.00
0.15 to 0.3 m	0.88	0.80	0.86	1.00	0.00	0.00	0.00	0.00
0.3 to 0.6 m	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Background Alarm Rates								
	P_{ba}^{res}: 0.12				**P_{ba}^{disc}:** 0.05			

[a]The two numbers to the right of the all types munitions result are an upper and lower 90 percent confidence level for an assumed binomial distribution.

[b]All depths are measured to the center of the object.

TABLE 6b. OPEN FIELD DIRECT FIRE TEST AREA RESULTS (not reported)

Response Stage					Discrimination Stage			
Munitions[a] Scores	P_d^{res}: by type				P_d^{disc}: by type			
	All Types	**105-mm**	**37-mm**	**25-mm**	**All Types**	**105-mm**	**37-mm**	**25-mm**
	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --
By Density								
High	--	--	--	--	--	--	--	--
Medium	--	--	--	--	--	--	--	--
Low	--	--	--	--	--	--	--	--
By Depth[b]								
0 to 4D	--	--	--	--	--	--	--	--
4D to 8D	--	--	--	--	--	--	--	--
8D to 12D	--	--	--	--	--	--	--	--
Clutter Scores	P_{cd}				P_{fp}			
By Mass								
By Depth[b]	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 10 kg**	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 10 kg**
All Depth	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --
0 to 0.15 m	--	--	--	--	--	--	--	--
0.15 to 0.3 m	--	--	--	--	--	--	--	--
0.3 to 0.6 m	--	--	--	--	--	--	--	--
Background Alarm Rates								
	BAR^{res}: --				**BAR^{disc}: --**			
Groups								
Found	--				--			
Identified	--				--			
Coverage	--				--			

[a]Note: The two numbers to the right of the all types munitions result are an upper and lower 90 percent confidence level for an assumed binomial distribution.

[b]All depths are measured to the center of the object.

TABLE 6c. OPEN FIELD INDIRECT FIRE TEST AREA RESULTS

Response Stage					Discrimination Stage			
Munitions[a] Scores	P_d^{res}: by type				P_d^{disc}: by type			
	All Types	**105-mm**	**81-mm**	**60-mm**	**All Types**	**105-mm**	**81-mm**	**60-mm**
	0.96 0.94 0.91	0.97 0.94 0.90	0.98 0.96 0.92	0.95 0.91 0.86	0.94 0.92 0.90	0.96 0.93 0.88	0.96 0.93 0.88	0.95 0.91 0.86
By Density								
High	0.89	0.96	0.91	0.80	0.88	0.92	0.91	0.80
Medium	0.97	0.97	0.96	0.97	0.94	0.97	0.89	0.97
Low	0.95	0.90	1.00	0.94	0.94	0.90	0.97	0.94
By Depth[b]								
0 to 4D	0.97	0.94	1.00	0.97	0.96	0.94	0.97	0.97
4D to 8D	0.93	0.97	0.92	0.86	0.92	0.94	0.92	0.86
8D to 12D	0.80	0.75	1.00	0.67	0.72	0.75	0.78	0.67
Clutter Scores	P_{cd}				P_{fp}			
By Mass								
By Depth[b]	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 10 kg**	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 10 kg**
All Depth	0.48 0.45 0.41	0.39	0.44	0.74	0.05 0.04 0.03	0.03	0.02	0.11
0 to 0.15 m	0.42	0.38	0.44	0.71	0.04	0.04	0.02	0.13
0.15 to 0.3 m	0.59	0.44	0.56	0.77	0.04	0.00	0.06	0.06
0.3 to 0.6 m	0.50	1.00	0.17	0.80	0.08	0.00	0.00	0.20
Background Alarm Rates								
BAR^{res}: 0.18					**BAR^{disc}:** 0.09			
Groups								
Found	0.93				0.83			
Identified	0.33				0.10			
Coverage	0.62				0.46			

[a]Note: The two numbers to the right of the all types munitions result are an upper and lower 90 percent confidence level for an assumed binomial distribution.

[b]All depths are measured to the center of the object.

TABLE 6d. OPEN FIELD LEGACY TEST AREA RESULTS (not reported)

Response Stage					Discrimination Stage			
Munitions[a] Scores	P_d^{res}: by type				P_d^{disc}: by type			
	All Types	**Small**	**Medium**	**Large**	**All Types**	**Small**	**Medium**	**Large**
	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --
By Depth[b]								
0 to 4D	--	--	--	--	--	--	--	--
4D to 8D	--	--	--	--	--	--	--	--
8D to 12D	--	--	--	--	--	--	--	--
> 12D	--	--	--	--	--	--	--	--
Clutter Scores	P_{cd}				P_{fp}			
By Mass								
By Depth[b]	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 10 kg**	**> 10 kg**	**All Mass**	**0 to 0.25 kg**	**>0.25 to 1 kg**	**>1 to 8 kg**	**< 10kg**
All Depth	-- -- --	--	--	--	--	-- -- --	--	--	--	--
0 to 0.15 m	--	--	--	--	--	--	--	--	--	--
0.15 to 0.3 m	--	--	--	--	--	--	--	--	--	--
0.3 to 0.6 m	--	--	--	--	--	--	--	--	--	--
> 0.6 m	--	--	--	--	--	--	--	--	--	--
Background Alarm Rates										
BAR^{res}: --						**BAR^{disc}: --**				
Groups										
Found	--					--				
Identified	--					--				
Coverage	--					--				

[a]Note: The two numbers to the right of the all types munitions result are an upper and lower 90 percent confidence level for an assumed binomial distribution.

[b]All depths are measured to the center of the object.

TABLE 6e. WOODED TEST AREA RESULTS (not covered)

Response Stage					Discrimination Stage			
Munitions[a] Scores	P_d^{res}: by type				P_d^{disc}: by type			
	All Types	Small	Medium	Large	All Types	Small	Medium	Large
	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --
By Depth[b]								
0 to 4D	--	--	--	--	--	--	--	--
4D to 8D	--	--	--	--	--	--	--	--
8D to 12D	--	--	--	--	--	--	--	--
> 12D	--	--	--	--	--	--	--	--
Clutter Scores	P_{cd}				P_{fp}			
By Mass								
By Depth[b]	All Mass	0 to 0.25 kg	>0.25 to 1 kg	>1 to 10 kg	> 10 kg	All Mass	0 to 0.25 kg	>0.25 to 1 kg	>1 to 8 kg	< 10kg
All Depth	-- -- --	--	--	--	--	-- -- --	--	--	--	--
0 to 0.15 m	--	--	--	--	--	--	--	--	--	--
0.15 to 0.3 m	--	--	--	--	--	--	--	--	--	--
0.3 to 0.6 m	--	--	--	--	--	--	--	--	--	--
> 0.6 m	--	--	--	--	--	--	--	--	--	--
Background Alarm Rates										
BAR^{res}: --					BAR^{disc}: --					
Groups										
Found	--				--					
Identified	--				--					
Coverage	--				--					

[a]Note: The two numbers to the right of the all types munitions result are an upper and lower 90 percent confidence level for an assumed binomial distribution.

[b]All depths are measured to the center of the object.

TABLE 6f. MOGUL TEST AREA RESULTS (not covered)

Response Stage					Discrimination Stage			
Munitions[a] Scores	P_d^{res}: by type				P_d^{disc}: by type			
	All Types	Small	Medium	Large	All Types	Small	Medium	Large
	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --	-- -- --
By Depth[b]								
0 to 4D	--	--	--	--	--	--	--	--
4D to 8D	--	--	--	--	--	--	--	--
8D to 12D	--	--	--	--	--	--	--	--
> 12D	--	--	--	--	--	--	--	--
Clutter Scores	P_{cd}				P_{fp}			
By Mass								
By Depth[b]	All Mass	0 to 0.25 kg	>0.25 to 1 kg	>1 to 10 kg	> 10 kg	All Mass	0 to 0.25 kg	>0.25 to 1 kg	>1 to 8 kg	< 10kg
All Depth	-- -- --	--	--	--	--	-- -- --	--	--	--	--
0 to 0.15 m	--	--	--	--	--	--	--	--	--	--
0.15 to 0.3 m	--	--	--	--	--	--	--	--	--	--
0.3 to 0.6 m	--	--	--	--	--	--	--	--	--	--
> 0.6 m	--	--	--	--	--	--	--	--	--	--
Background Alarm Rates										
	BAR^{res}: --					**BAR^{disc}: --**				
Groups										
Found	--					--				
Identified	--					--				
Coverage	--					--				

[a]Note: The two numbers to the right of the all types munitions result are an upper and lower 90 percent confidence level for an assumed binomial distribution.

[b]All depths are measured to the center of the object.

4.3 EFFICIENCY, REJECTION RATES, AND TYPE CLASSIFICATION

Efficiency and rejection rates are calculated to quantify the discrimination ability at specific points of interest on the ROC curve: one at the point where no decrease in P_d is suffered (i.e., the efficiency is by definition equal to one) and the other at the operator selected threshold. These values are presented in Table 7a through 7d.

TABLE 7a. BLIND GRID EFFICIENCY AND REJECTION RATES

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	0.99	0.99	0.61
With No Loss of P_d	1.00	0.95	0.57

TABLE 7b. OPEN FIELD (DIRECT) EFFICIENCY AND REJECTION RATES (not reported)

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	--	--	--
With No Loss of P_d	--	--	--

TABLE 7c. OPEN FIELD (INDIRECT) EFFICIENCY AND REJECTION RATES

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	0.98	0.92	0.48
With No Loss of P_d	1.00	0.58	0.03

TABLE 7d. OPEN FIELD (LEGACY) EFFICIENCY AND REJECTION RATES (not reported)

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	--	--	--
With No Loss of P_d	--	--	--

TABLE 7e. WOODED EFFICIENCY AND REJECTION RATES (not covered)

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	--	--	--
With No Loss of P_d	--	--	--

TABLE 7f. MOGUL EFFICIENCY AND REJECTION RATES (not covered)

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	--	--	--
With No Loss of P_d	--	--	--

At the demonstrator's recommended setting, the munitions items that were detected and correctly discriminated were further scored on whether their correct type could be identified (table 8a through 8f). Correct type examples include 20-mm projectile, 105-mm HEAT projectile, and 2.75-inch Rocket. A list of the standard type declaration required for each munitions item was provided to demonstrators prior to testing. The standard types for the three example items are 20-mmP, 105H, and 2.75-inch.

TABLE 8a. BLIND GRID CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS MUNITIONS

Size	Percentage
25mm	100
37mm	100
60mm	100
81mm	93
105mm	7
105 artillery	0
Overall	67

Note: The demonstrator did not attempt to provide type classification (if applicable).

TABLE 8b. OPEN FIELD DIRECT FIRE CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS MUNITIONS (not reported)

Size	Percentage
25mm	--
37mm	--
105mm	--
Overall	--

TABLE 8c. OPEN FIELD INDIRECT FIRE CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS MUNITIONS

Size	Percentage
60mm	90
81mm	87
105mm	92
Overall	90

TABLE 8d. OPEN FIELD LEGACY CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS MUNITIONS (not reported)

Size	Percentage
Small	--
Medium	--
Large	--
Overall	--

TABLE 8e. WOODED CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS MUNITIONS (not covered)

Size	Percentage
Small	--
Medium	--
Large	--
Overall	--

TABLE 8f. MOGUL CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS MUNITIONS (not covered)

Size	Percentage
Small	--
Medium	--
Large	--
Overall	--

4.4 LOCATION ACCURACY

The mean location error and standard deviations appear in Tables 9a through 9f. These calculations are based on average missed distance for munitions correctly identified during the response stage. Depths are measured from the center of the munitions to the surface. For the blind grid, only depth errors are calculated because (X, Y) positions are known to be the centers of the grid square.

TABLE 9a. BLIND GRID MEAN LOCATION ERROR AND STANDARD DEVIATION

	Mean	Standard Deviation
Northing	N/A	N/A
Easting	N/A	N/A
Depth	0.02	0.04

TABLE 9b. OPEN FIELD DIRECT FIRE MEAN LOCATION ERROR AND STANDARD DEVIATION (not reported)

	Mean	Standard Deviation
Northing	--	--
Easting	--	--
Depth	--	--

TABLE 9c. OPEN FIELD INDIRECT FIRE MEAN LOCATION ERROR AND STANDARD DEVIATION

	Mean	Standard Deviation
Northing	0.01	0.05
Easting	0.01	0.05
Depth	0.00	0.06

TABLE 9d. OPEN FIELD LEGACY MEAN LOCATION ERROR AND STANDARD DEVIATION (not reported)

	Mean	Standard Deviation
Northing	--	--
Easting	--	--
Depth	--	--

TABLE 9e. WOODED MEAN LOCATION ERROR AND STANDARD DEVIATION (not covered)

	Mean	Standard Deviation
Northing	--	--
Easting	--	--
Depth	--	--

TABLE 9f. MOGUL MEAN LOCATION ERROR AND STANDARD DEVIATION (not covered)

	Mean	Standard Deviation
Northing	--	--
Easting	--	--
Depth	--	--

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SECTION 5. ON-SITE LABOR REQUIREMENTS

A standardized estimate for labor associated with this effort was calculated as follows: the first person at the test site was designated supervisor, the second person was designated data analyst, and the third and following personnel were considered field support.

Government representatives monitored on-site activity. All on-site activities were grouped into one of ten categories: initial setup/mobilization, daily setup/stop, calibration, collecting data, downtime due to break/lunch, downtime due to equipment failure, downtime due to equipment/data checks or maintenance, downtime due to weather, downtime due to demonstration site issue, or demobilization. See Appendix D for the daily activity log. See section 3.4 for a summary of field activities.

The standardized estimate of the labor needed to perform the field activities is presented in Table 10. Note that calibration time includes time spent in the calibration lanes as well as field calibrations. Site survey includes daily setup/stop time, collecting data, breaks/lunch, downtime due to equipment/data checks or maintenance, downtime due to failure, and downtime due to weather.

TABLE 10. ON-SITE LABOR REQUIREMENTS

	No. of People	Hours
	Initial setup	
Supervisor	1	0.83
Data analyst	1	0.83
Field support	2	0.83
Subtotal		
	Calibration site survey	
Supervisor	1	5.96
Data analyst	1	5.96
Field support	2	5.96
Subtotal		
	Blind grid site survey	
Supervisor	1	10.03
Data analyst	1	10.03
Field support	2	10.03
Subtotal		

See notes at end of table.

TABLE 10. (CONT'D)

	No. of People	Hours
	Open field site survey	
Supervisor	1	39.96
Data analyst	1	39.96
Field support	2	39.96
Subtotal		
	Wooded site survey (not covered)	
Supervisor	--	--
Data analyst	--	--
Field support	--	--
Subtotal		
	Mogul site survey (not covered)	
Supervisor	--	--
Data analyst	--	--
Field support	--	--
Subtotal		
	Demobilization	
Supervisor	1	3.16
Data analyst	1	3.16
Field support	2	3.16
Subtotal		

Notes: Calibration time includes time spent in the calibration lanes as well as calibration before each data run.

Site survey time includes daily setup/stop time, collecting data, breaks/lunch, downtime due to system maintenance, failure, and weather.

SECTION 6. APPENDIXES

APPENDIX A. TERMS AND DEFINITIONS

GENERAL DEFINITIONS

Anomaly: Location of a system response deemed to warrant further investigation by the demonstrator for consideration as an emplaced munitions item.

Detection: An anomaly location that is within R_{halo} of an emplaced munitions item.

Military Munitions (MM): Specific categories of MM that may pose unique explosive safety risks, including UXO as defined in 10 USC 101(e)(5), DMM as defined in 10 USC 2710(e)(2) and/or munitions constituents (e.g. TNT, RDX) as defined in 10 USC 2710(e)(3) that are present in high enough concentrations to pose an explosive hazard.

Emplaced Munitions: A munitions item buried by the government at a specified location in the test site.

Emplaced Clutter: A clutter item (i.e., nonmunitions item) buried by the government at a specified location in the test site.

R_{halo}: A predetermined radius about an emplaced item (clutter or munitions) within which an anomaly identified by the demonstrator as being of interest is considered to be a detection of that item. For the purpose of this program, a circular halo 0.5 meters in radius is placed around the center of the object for all clutter and munitions items.

Small Munitions: Caliber of munitions less than or equal to 40 mm (includes 20-mm projectile, 25-mm projectile, 37-mm projectile, 40-mm projectile, submunitions BLU-26, BLU-63, and M42).

Medium Munitions: Caliber of munitions greater than 40 mm and less than or equal to 81 mm (includes 57-mm projectile, 60-mm mortar, 2.75-inch rocket, and 81-mm mortar).

Large Munitions: Caliber of munitions greater than 81 mm (includes 105-mm HEAT, 105-mm projectile, and 155-mm projectile).

Group: Two or more adjacent GT items with overlapping halos.

GT: Ground truth

Response Stage Noise Level: The level that represents the signal level below which anomalies are not considered detectable. Demonstrators are required to provide the recommended noise level for the blind grid test area.

Discrimination Stage Threshold: The demonstrator-selected threshold level that is expected to provide optimum performance of the system by retaining all detectable munitions and rejecting the maximum amount of clutter. This level defines the subset of anomalies the demonstrator would recommend digging based on discrimination.

Binomially Distributed Random Variable: A random variable of the type which has only two possible outcomes, say success and failure, is repeated for *n* independent trials with the probability *p* of success and the probability *1-p* of failure being the same for each trial. The number of successes *x* observed in the *n* trials is an estimate of *p* and is considered to be a binomially distributed random variable.

RESPONSE AND DISCRIMINATION STAGE DATA

The scoring of the demonstrator's performance is conducted in two stages: response stage and discrimination stage. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of clutter detection (P_{cd}) or probability of false positive (P_{fp}). Those that do not correspond to any known item are termed background alarms.

The response stage is a measure of whether the sensor can detect an object of interest. For a channel instrument, this value should be closely related to the amplitude of the signal. The demonstrator must report the response level (threshold) below which target responses are deemed insufficient to warrant further investigation. At this stage, minimal processing may be done. This includes filtering long- and short-scale variations, bias removal, and scaling. This processing should be detailed in the data submission.

For a multichannel instrument, the demonstrator must construct a quantity analogous to amplitude. The demonstrator should consider what combination of channels provides the best test for detecting any object that the sensor can detect. The average amplitude across a set of channels is an example of an acceptable response stage quantity. Other methods may be more appropriate for a given sensor. Again, minimal processing can be done, and the demonstrator should explain how this quantity was constructed in their data submission.

The discrimination stage evaluates the demonstrator's ability to correctly identify munitions as such, and to reject clutter. For the same locations as in the response stage anomaly list, the discrimination stage list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain munitions. Thus, higher output values are indicative of higher confidence that a munitions item is present at the specified location. For electronic signal processing, priority ranking is based on algorithm output. For other systems, priority ranking is based on human judgment. The demonstrator also selects the threshold that the demonstrator believes will provide optimum system performance, (i.e., that retains all the detected munitions and rejects the maximum amount of clutter).

Note: The two lists provided by the demonstrator contain identical numbers of potential target locations. They differ only in the priority ranking of the declarations.

GROUP SCORING FACTORS

Based on configuration of the GT at the standardized sites and the defined scoring methodology, there exists munitions groups defined as having overlapping halos. In these cases, the following scoring logic is implemented (fig. A-1 through A-9):

a. Overall site scores (i.e., P_d) will consider only isolated munitions and clutter items.

b. GT items that have overlapping halos (both munitions and clutter) will form a group and groups may form chains.

c. Groups will have a complex halos composed of all the composite halos of all its GT items.

d. Groups will have three scoring factors: groups found groups identified and group coverage. Scores will be based on 1:1 matches of anomalies and GT.

(1) Groups Found (Found): the number of groups that have one or more GT items matched divided by the total number of groups. Demonstrators will be credited with detecting a group if any item within the group is matched to an anomaly in their list.

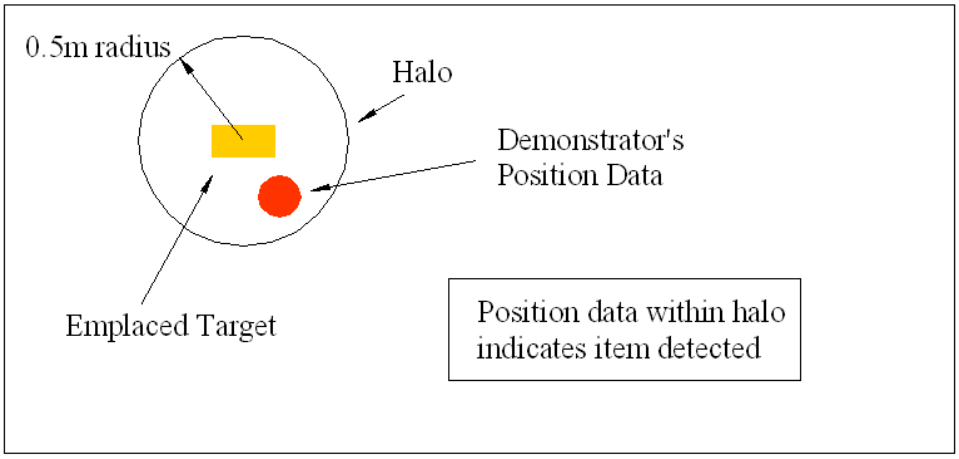
(2) Groups Identified (ID): the number of groups that have two or more GT items matched divided by the total number of groups. Demonstrators will be credited with identifying that a group is present if multiple items within the composite halo are matched to anomalies in their list.

(3) Group Coverage (Coverage): the number of GT items matched within groups divided by the total number of GT items within groups. This metric measures the demonstrator accuracy in determining the number of anomalies within a group. If five items are present and only two anomalies are matched, the demonstrator will score 0.4. If all five are matched the demonstrator will score 1.0.

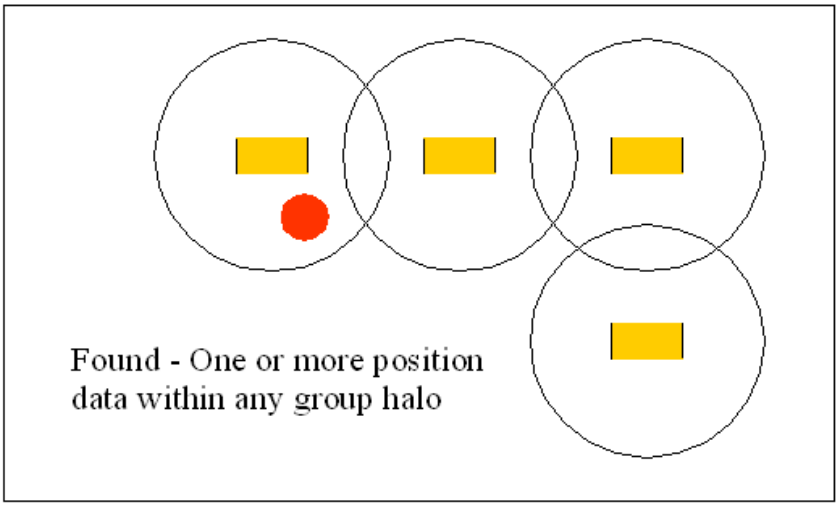
e. Location error will not be reported for groups.

f. Demonstrators will not be asked to call out groups in their scoring submissions. If multiple anomalies are indicated in a small area, the demonstrator will report all individual anomalies.

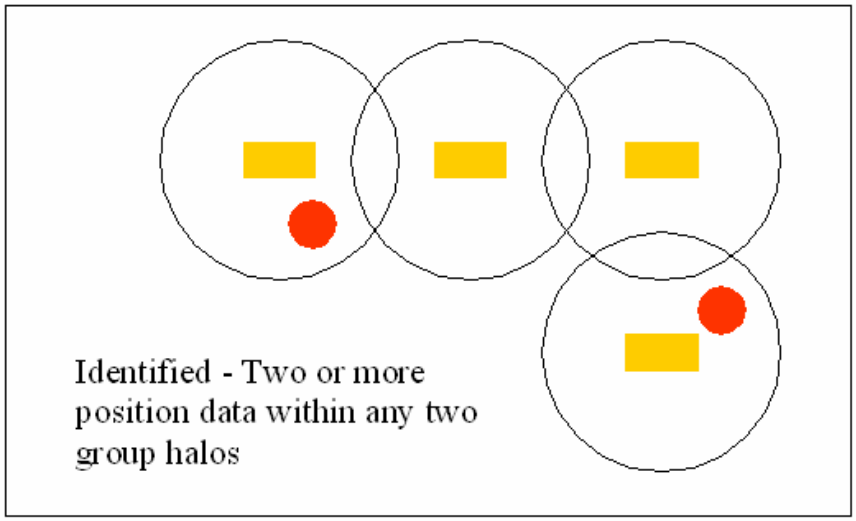
g. Excess alarms within a halo will be disregarded.



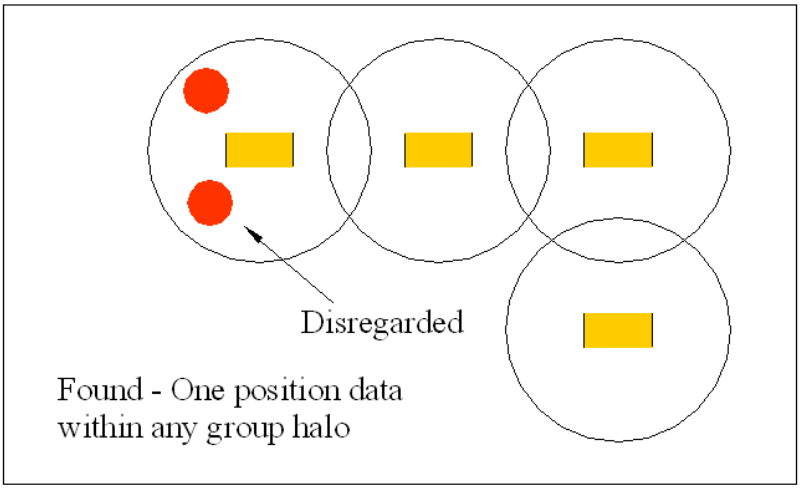
A-1. Example of detected item.



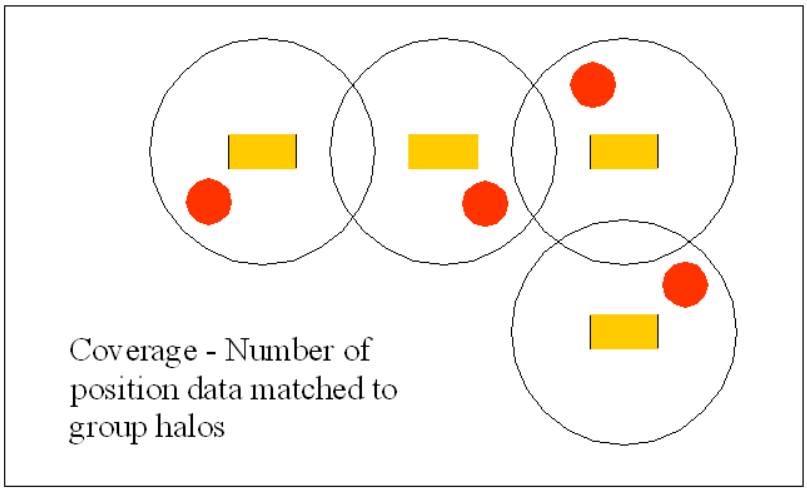
A-2. Example of group found (found).



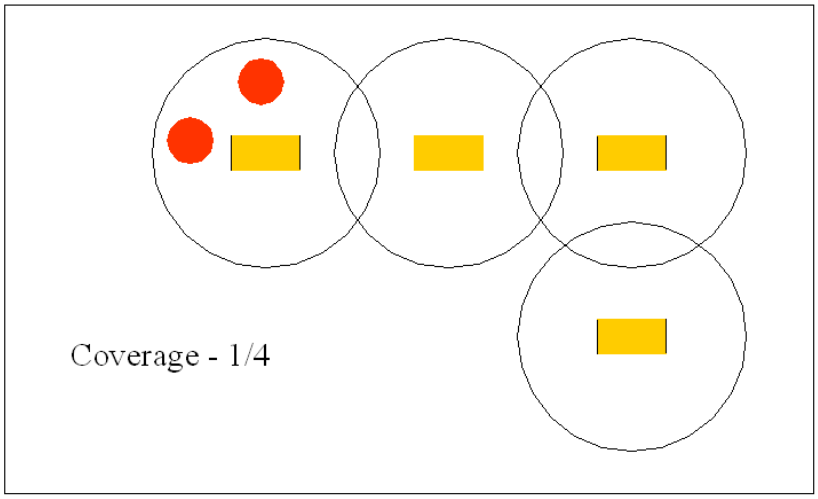
A-3. Example of group identified (ID).



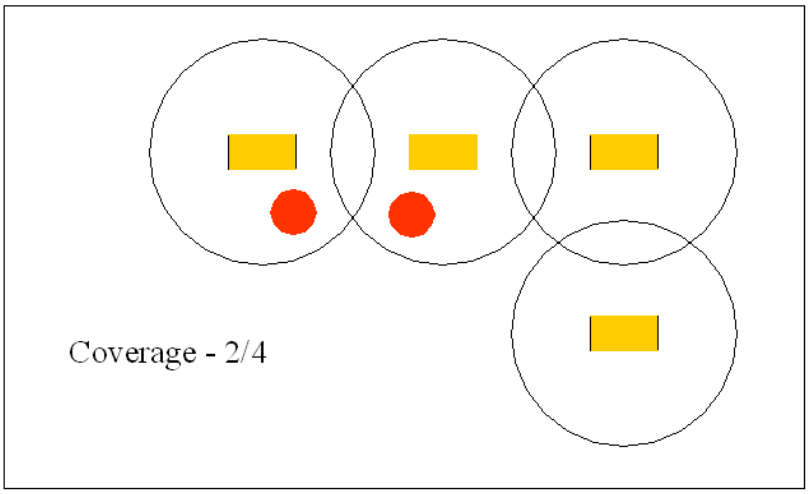
A-4. Example of excess alarms disregarded.



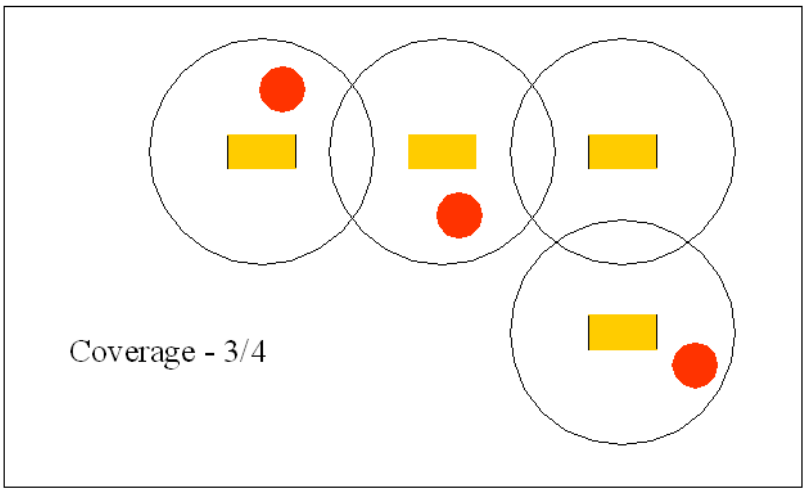
A-5. Example of a group.



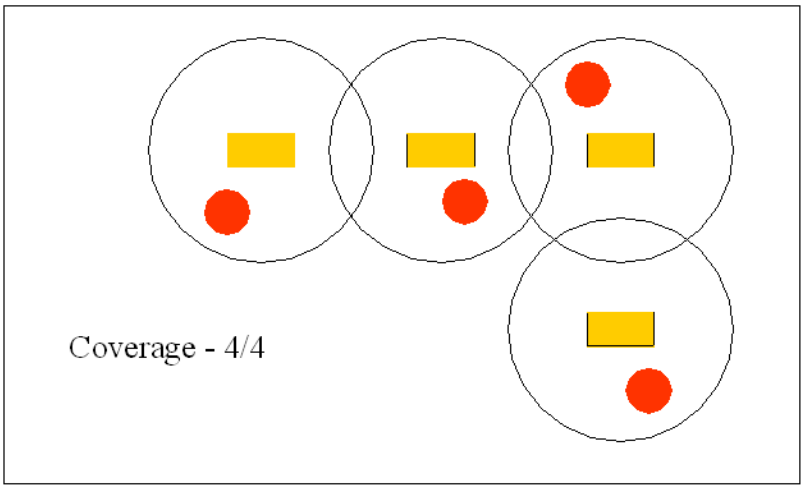
A-6. Example of group (1/4 = 0.25).



A-7. Example of group (2/4 = 0.5).



A-8. Example of group (3/4 = 0.75).



A-9. Example of group (4/4 = 1.0).

RESPONSE STAGE DEFINITIONS

Response Stage Probability of Detection (P_d^{res}): P_d^{res} = (No. of response-stage detections)/ (No. of emplaced munitions in the test site).

Response Stage Clutter Detection (cd^{res}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Response Stage Probability of Clutter Detection (P_{cd}^{res}): P_{cd}^{res} = (No. of response-stage clutter detections)/(No. of emplaced clutter items).

Response Stage Background Alarm (ba^{res}): An anomaly in a blind grid cell that contains neither emplaced munitions nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced munitions or emplaced clutter item.

Response Stage Probability of Background Alarm (P_{ba}^{res}): Blind grid only: P_{ba}^{res} = (No. of response-stage background alarms)/(No. of empty grid locations).

Response Stage Background Alarm Rate (BAR^{res}): Open field any challenge area (including the direct and indirect firing sub areas) only: BAR^{res} = (No. of response-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{res}, P_{cd}^{res}, P_{ba}^{res}, and BAR^{res} are functions of t^{res}, the threshold applied to the response-stage signal strength. These quantities can therefore be written as $P_d^{res}(t^{res})$, $P_{cd}^{res}(t^{res})$, $P_{ba}^{res}(t^{res})$, and $BAR^{res}(t^{res})$.

DISCRIMINATION STAGE DEFINITIONS

Discrimination: The application of a signal processing algorithm or human judgment to sensor data to discriminate munitions from clutter. Discrimination should identify anomalies that the demonstrator has high confidence correspond to munitions, as well as those that the demonstrator has high confidence correspond to nonmunitions or background returns. The former should be ranked with highest priority and the latter with lowest.

Discrimination Stage Probability of Detection (P_d^{disc}): P_d^{disc} = (No. of discrimination-stage detections)/(No. of emplaced munitions in the test site).

Discrimination Stage False Positive (fp^{disc}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Discrimination Stage Probability of False Positive (P_{fp}^{disc}): P_{fp}^{disc} = (No. of discrimination stage false positives)/(No. of emplaced clutter items).

Discrimination Stage Background Alarm (ba^{disc}): An anomaly in a blind grid cell that contains neither emplaced munitions nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced munitions or emplaced clutter item.

Discrimination Stage Probability of Background Alarm (P_{ba}^{disc}): P_{ba}^{disc} = (No. of discrimination-stage background alarms)/(No. of empty grid locations).

Discrimination Stage Background Alarm Rate (BAR^{disc}): BAR^{disc} = (No. of discrimination-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{disc}, P_{fp}^{disc}, P_{ba}^{disc}, and BAR^{disc} are functions of t^{disc}, the threshold applied to the discrimination-stage signal strength. These quantities can therefore be written as $P_d^{disc}(t^{disc})$, $P_{fp}^{disc}(t^{disc})$, $P_{ba}^{disc}(t^{disc})$, and $BAR^{disc}(t^{disc})$.

RECEIVER-OPERATING CHARACERISTIC (ROC) CURVES

ROC curves at both the response and discrimination stages can be constructed based on the above definitions. The ROC curves plot the relationship between P_d versus P_{cd} or P_{fp} and P_d versus BAR or P_{ba} as the threshold applied to the signal strength is varied from its minimum (t_{min}) to its maximum (t_{max}) value.[1] P_d versus P_{fp} and P_d versus BAR being combined into ROC curves is shown in Figure A-10. Note that the "res" and "disc" superscripts have been suppressed from all the variables for clarity.

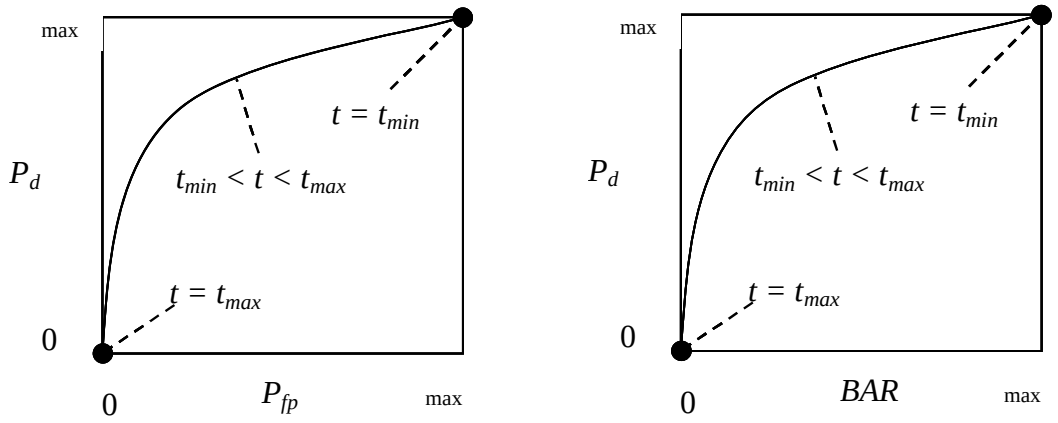


Figure A-10. ROC curves for open field testing. Each curve applies to both the response and discrimination stages.

METRICS TO CHARACTERIZE THE DISCRIMINATION STAGE

The demonstrator is also scored on efficiency and rejection ratio, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of munitions detections from the anomaly list while rejecting the maximum number of anomalies arising from nonmunitions items. The efficiency measures the fraction of detected munitions retained by the discrimination, while the rejection ratio measures the fraction of false alarms rejected. Both measures are defined relative to the entire response list, i.e., the maximum munitions detectable by the sensor and its accompanying clutter detection rate/false positive rate or background alarm rate.

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[1]Strictly speaking, ROC curves plot the P_d versus P_{ba} over a predetermined and fixed number of detection opportunities (some of the opportunities are located over munitions and others are located over clutter or blank spots). In an open field scenario, each system suppresses its signal strength reports until some bare-minimum signal response is received by the system. Consequently, the open field ROC curves do not have information from low signal-output locations, and, furthermore, different contractors report their signals over a different set of locations on the ground. These ROC curves are thus not true to the strict definition of ROC curves as defined in textbooks on detection theory. Note, however, that the ROC curves obtained in the blind grid test sites are true ROC curves.

Efficiency (E): $E = P_d^{disc}(t^{disc})/P_d^{res}(t_{min}^{res})$: Measures (at a threshold of interest) the degree to which the maximum theoretical detection performance of the sensor system (as determined by the response stage tmin) is preserved after application of discrimination techniques. Efficiency is a number between 0 and 1. An efficiency of 1 implies that all of the munitions initially detected in the response stage were retained at the specified threshold in the discrimination stage, t^{disc}.

False Positive Rejection Rate (R_{fp}): $R_{fp} = 1 - [P_{fp}^{disc}(t^{disc})/P_{cd}^{res}(t_{min}^{res})]$: Measures (at a threshold of interest) the degree to which the sensor system's false positive performance is improved over the maximum false positive performance (as determined by the response stage tmin). The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all emplaced clutter initially detected in the response stage were correctly rejected at the specified threshold in the discrimination stage.

Background Alarm Rejection Rate (R_{ba}):

Blind grid: $R_{ba} = 1 - [P_{ba}^{disc}(t^{disc})/P_{ba}^{res}(t_{min}^{res})]$.
Open field: $R_{ba} = 1 - [BAR^{disc}(t^{disc})/BAR^{res}(t_{min}^{res})])$.

Measures the degree to which the discrimination stage correctly rejects background alarms initially detected in the response stage. The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all background alarms initially detected in the response stage were rejected at the specified threshold in the discrimination stage.

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APPENDIX B. DAILY WEATHER LOGS

Date, 2008	Time, EST	Avg Temp., °F	Total Precip., In
7 May	7:00	52.9	0.00
7 May	8:00	62.4	0.00
7 May	9:00	68.4	0.00
7 May	10:00	72.3	0.00
7 May	11:00	76.5	0.00
7 May	12:00	78.1	0.00
7 May	13:00	79.2	0.00
7 May	14:00	79.7	0.00
7 May	15:00	80.2	0.00
7 May	16:00	80.2	0.00
7 May	17:00	79.3	0.00
16 Jun	7:00	69.6	0.00
16 Jun	8:00	74.5	0.00
16 Jun	9:00	76.6	0.00
16 Jun	10:00	81.3	0.00
16 Jun	11:00	83.1	0.00
16 Jun	12:00	84.6	0.00
16 Jun	13:00	85.5	0.00
16 Jun	14:00	85.6	0.00
16 Jun	15:00	84.7	0.00
16 Jun	16:00	79.3	0.00
16 Jun	17:00	72.1	0.01
17 Jun	7:00	66.9	0.00
17 Jun	8:00	70.0	0.00
17 Jun	9:00	72.9	0.00
17 Jun	10:00	75.9	0.00
17 Jun	11:00	77.4	0.00
17 Jun	12:00	77.0	0.00
17 Jun	13:00	76.1	0.00
17 Jun	14:00	76.5	0.00
17 Jun	15:00	74.8	0.00
17 Jun	16:00	74.5	0.00
17 Jun	17:00	74.7	0.00
18 Jun	7:00	61.5	0.00
18 Jun	8:00	66.4	0.00
18 Jun	9:00	69.1	0.00
18 Jun	10:00	72.0	0.00
18 Jun	11:00	73.2	0.00
18 Jun	12:00	73.6	0.00
18 Jun	13:00	73.4	0.00
18 Jun	14:00	76.1	0.00

Date, 2008	Time, EST	Avg Temp., °F	Total Precip., In
18 Jun	15:00	75.6	0.00
18 Jun	16:00	76.5	0.00
18 Jun	17:00	75.0	0.00
19 Jun	7:00	59.9	0.00
19 Jun	8:00	64.2	0.00
19 Jun	9:00	67.3	0.00
19 Jun	10:00	68.7	0.00
19 Jun	11:00	70.5	0.00
19 Jun	12:00	72.0	0.00
19 Jun	13:00	73.0	0.00
19 Jun	14:00	73.9	0.00
19 Jun	15:00	74.7	0.00
19 Jun	16:00	75.2	0.00
19 Jun	17:00	75.6	0.00
20 Jun	7:00	62.4	0.00
20 Jun	8:00	68.5	0.00
20 Jun	9:00	72.7	0.00
20 Jun	10:00	75.0	0.00
20 Jun	11:00	77.5	0.00
20 Jun	12:00	78.3	0.00
20 Jun	13:00	78.3	0.00
20 Jun	14:00	80.8	0.00
20 Jun	15:00	81.3	0.00
20 Jun	16:00	81.0	0.00
20 Jun	17:00	81.0	0.00
23 Jun	7:00	71.6	0.00
23 Jun	8:00	72.3	0.00
23 Jun	9:00	73.4	0.00
23 Jun	10:00	75.4	0.00
23 Jun	11:00	78.1	0.00
23 Jun	12:00	80.6	0.00
23 Jun	13:00	82.9	0.00
23 Jun	14:00	80.8	0.00
23 Jun	15:00	82.4	0.00
23 Jun	16:00	82.2	0.00
23 Jun	17:00	83.7	0.00

APPENDIX C. SOIL MOISTURE

Date: 5 May 08			
Times: 0700 through 1800			
Probe Location:	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Wooded area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Open area	0 to 6	37.6	37.4
	6 to 12	39.2	39.0
	12 to 24	45.8	45.9
	24 to 36	47.2	47.1
	36 to 48	51.2	51.4
Calibration lanes	0 to 6	11.2	11.4
	6 to 12	15.9	15.7
	12 to 24	24.7	24.9
	24 to 36	28.9	28.8
	36 to 48	32.3	32.3
Blind grid/moguls	0 to 6	12.9	12.8
	6 to 12	10.7	10.6
	12 to 24	25.2	25.3
	24 to 36	19.4	19.1
	36 to 48	26.8	26.7

Date: 16 Jun 08			
Times: 0700 through 1800			
Probe Location:	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Wooded area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Open area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Calibration lanes	0 to 6	12.8	12.7
	6 to 12	14.8	14.8
	12 to 24	22.6	22.7
	24 to 36	26.5	26.3
	36 to 48	33.7	33.6
Blind grid/moguls	0 to 6	11.7	11.6
	6 to 12	9.8	9.7
	12 to 24	23.7	23.5
	24 to 36	18.8	18.6
	36 to 48	24.9	24.6

Date: 17 Jun 08			
Times: 0700 through 1800			
Probe Location:	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Wooded area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Open area	0 to 6	N/A	38.9
	6 to 12	N/A	36.2
	12 to 24	N/A	43.4
	24 to 36	N/A	49.6
	36 to 48	N/A	47.2
Calibration lanes	0 to 6	12.9	12.6
	6 to 12	15.3	15.1
	12 to 24	22.4	22.3
	24 to 36	26.2	26.1
	36 to 48	33.5	33.5
Blind grid/moguls	0 to 6	11.9	11.8
	6 to 12	9.9	9.8
	12 to 24	23.6	23.3
	24 to 36	18.9	18.8
	36 to 48	24.5	24.4

Date: 18 Jun 08			
Times: 0700 through 1800			
Probe Location:	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Wooded area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Open area	0 to 6	38.6	38.5
	6 to 12	35.8	35.7
	12 to 24	43.3	43.2
	24 to 36	49.5	49.3
	36 to 48	46.8	46.7
Calibration lanes	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Blind grid/moguls	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A

Date: 19 Jun 08			
Times: 0700 through 1800			
Probe Location:	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Wooded area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Open area	0 to 6	38.8	38.6
	6 to 12	35.5	35.3
	12 to 24	43.0	42.8
	24 to 36	49.2	49.1
	36 to 48	46.4	46.3
Calibration lanes	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Blind grid/moguls	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A

Date: 20 Jun 08			
Times: 0700 through 1800			
Probe Location:	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Wooded area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Open area	0 to 6	38.4	38.3
	6 to 12	35.2	35.1
	12 to 24	42.5	42.4
	24 to 36	48.7	48.6
	36 to 48	46.1	46.1
Calibration lanes	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Blind grid/moguls	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A

Date: 23 Jun 08			
Times: 0700 through 1800			
Probe Location:	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Wooded area	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Open area	0 to 6	38.0	N/A
	6 to 12	34.4	N/A
	12 to 24	42.1	N/A
	24 to 36	48.1	N/A
	36 to 48	45.7	N/A
Calibration lanes	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A
Blind grid/moguls	0 to 6	N/A	N/A
	6 to 12	N/A	N/A
	12 to 24	N/A	N/A
	24 to 36	N/A	N/A
	36 to 48	N/A	N/A

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APPENDIX D. DAILY ACTIVITY LOGS

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/7/2008	3	OPEN FIELD	800	815	15	INITIAL SET-UP	INITIAL MOBILIZATION	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	815	845	30	DAILY START, STOP	SET UP EQUIPMENT	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	845	915	30	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	915	945	30	DOWNTIME DUE TO EQUIPMENT FAILURE	FAULTY GPS SATELLITES	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	945	1020	35	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1020	1025	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1025	1120	55	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1120	1125	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1125	1225	60	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1225	1230	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1230	1325	55	COLLECTING DATA	COLLECT DATA BLIND GRID, OPEN FIELD, CALIBRATION GRID	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1325	1330	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1330	1340	10	BREAK/LUNCH	LUNCH	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1340	1355	15	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1355	1420	25	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/7/2008	3	OPEN FIELD	1420	1520	60	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1520	1525	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1525	1620	55	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/7/2008	3	OPEN FIELD	1620	1700	40	DEMOBILIZATION	DEMOBILIZATION	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	750	825	35	INITIAL SET-UP	INITIAL MOBILIZATION	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	825	850	25	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	850	855	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	855	915	20	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	915	920	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	920	935	15	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	935	940	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	940	1020	40	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1020	1025	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1025	1100	35	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1100	1105	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1105	1135	30	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1135	1140	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/16/2008	4	CALIBRATION LANES	1140	1150	10	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1150	1155	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1155	1205	10	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1205	1210	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1210	1235	25	BREAK/LUNCH	BREAK	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	CALIBRATION LANES	1235	1255	20	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	BLIND TEST GRID	1255	1335	40	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	BLIND TEST GRID	1335	1340	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	BLIND TEST GRID	1340	1445	65	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	BLIND TEST GRID	1445	1455	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	BLIND TEST GRID	1455	1545	50	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	BLIND TEST GRID	1545	1550	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/16/2008	4	BLIND TEST GRID	1550	1605	15	DAILY START, STOP	EQUIPMENT BREAKDOWN	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	730	755	25	DAILY START, STOP	SET UP EQUIPMENT	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	755	810	15	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	810	855	45	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/17/2008	4	BLIND TEST GRID	855	905	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	905	920	15	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	920	925	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	925	940	15	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	940	945	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	945	1010	25	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1010	1015	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1015	1030	15	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1030	1035	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1035	1055	20	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1055	1100	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1100	1115	15	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1115	1130	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1130	1210	40	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1210	1220	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/17/2008	4	BLIND TEST GRID	1220	1235	15	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1235	1240	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1240	1315	35	COLLECTING DATA	COLLECTING DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	BLIND TEST GRID	1315	1420	65	DOWNTIME DUE TO EQUIP MAINT/CHECK	DATA CHECK	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	OPEN FIELD	1420	1615	115	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	OPEN FIELD	1615	1620	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/17/2008	4	OPEN FIELD	1620	1645	25	DAILY START, STOP	EQUIPMENT BREAKDOWN	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	720	745	25	DAILY START, STOP	SET UP EQUIPMENT	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	745	750	5	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	750	905	75	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	905	910	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	910	1020	70	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1020	1025	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1025	1110	45	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1110	1120	10	DOWNTIME DUE TO EQUIPMENT FAILURE	FAULTY SATELITTES	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1120	1215	55	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/18/2008	4	OPEN FIELD	1215	1220	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1220	1450	150	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1450	1455	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1455	1550	55	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1550	1555	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1555	1700	65	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1700	1705	5	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
6/18/2008	4	OPEN FIELD	1705	1725	20	DAILY START, STOP	EQUIPMENT BREAKDOWN	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	730	810	40	DAILY START, STOP	SET UP EQUIPMENT	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	810	825	15	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	825	855	30	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	855	900	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	900	1015	75	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1015	1020	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1020	1105	45	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1105	1115	10	DOWNTIME DUE TO EQUIPMENT FAILURE	FAULTY SATELITTES	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1115	1205	50	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1205	1210	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
06/19/08	4	OPEN FIELD	1210	1315	65	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1315	1325	10	DOWNTIME DUE TO EQUIPMENT FAILURE	VEHICLE STUCK IN MUD	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1325	1350	25	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1350	1355	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1355	1525	90	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1525	1530	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1530	1635	65	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1635	1640	5	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
06/19/08	4	OPEN FIELD	1640	1655	15	DAILY START, STOP	EQUIPMENT BREAKDOWN	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	715	750	35	DAILY START, STOP	SET UP EQUIPMENT	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	750	755	5	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	755	825	30	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	825	830	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	830	935	65	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	935	940	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	940	1105	85	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
06/20/08	4	OPEN FIELD	1105	1110	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	1110	1310	120	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	1310	1315	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	1315	1520	125	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	1520	1525	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOAD DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	1525	1650	85	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	1650	1700	10	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	SUNNY	MUDDY
06/20/08	4	OPEN FIELD	1700	1720	20	DAILY START, STOP	EQUIPMENT BREAKDOWN	GPS	NA	LINEAR	SUNNY	MUDDY
06/23/08	4	OPEN FIELD	730	800	30	DAILY START, STOP	SET UP EQUIPMENT	GPS	NA	LINEAR	CLOUDY	DRY
06/23/08	4	OPEN FIELD	800	810	10	CALIBRATION	CALIBRATION	GPS	NA	LINEAR	CLOUDY	DRY
06/23/08	4	OPEN FIELD	810	830	20	COLLECTING DATA	INDIRECT FIRE COLLECT DATA	GPS	NA	LINEAR	CLOUDY	DRY
06/23/08	4	OPEN FIELD	825	850	25	DOWNTIME DUE TO EQUIP MAINT/CHECK	DATA CHECK	GPS	NA	LINEAR	CLOUDY	DRY
06/23/08	4	OPEN FIELD	850	1120	150	DEMOBILIZATION	DEMOBILIZATION	GPS	NA	LINEAR	CLOUDY	DRY

APPENDIX E. REFERENCES

1. Standardized UXO Technology Demonstration Site Handbook, DTC Project No. 8-CO-160-000-473, Report No. ATC-8349, March 2002.

2. Aberdeen Proving Ground Soil Survey Report, October 1998.

3. Data Summary, UXO Standardized Test Site: APG Soils Description, May 2002.

4. Yuma Proving Ground Soil Survey Report, May 2003.

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APPENDIX F. ABBREVIATIONS

APG = Aberdeen Proving Ground
ASCII = American Standard Code for Information Interchange.
ATC = U.S. Army Aberdeen Test Center
ba^{disc} = discrimination stage background alarm
BAR = background alarm rate
BAR^{disc} = discrimination stage background alarm rate
ba^{res} = response stage background alarm
BAR^{res} = response stage background alarm rate
cd^{res} = response stage clutter detection
DMM = discarded military munitions
e = efficiency
EMI = electromagnetic interference
EQT = Army Environmental Quality Technology Program
ERDC = U.S. Army Corps of Engineers Engineering Research and Development Center
ESTCP = Environmental Security Technology Certification Program
fp^{disc} = discrimination stage false positive
GPS = Global Positioning System
GT = ground truth
HEAT = high-explosive antitank
JPG = Jefferson Proving Ground
MM = military munition
NS = nonstandard munition
P_{ba} = probability of background alarm
P_{ba}^{disc} = discrimination stage background alarm
P_{ba}^{res} = response stage background alarm
P_{cd} = probability of clutter detection
P_{cd}^{res} = response stage probability of clutter detection
P_d = probability of detection
P_d^{disc} = discrimination stage probability of detection
P_d^{res} = response stage probability of detection
P_{fp} = probability of false positive
P_{fp}^{disc} = discrimination stage probability of false positive
POC = point of contact
QA = quality assurance
QC = quality control
R_{fp} = false positive rejection rate
R_{halo} = Halo Radius
ROC = receiver-operating characteristic
S = standard munition
SERDP = Strategic Environmental Research and Development Program
t^{disc} = discrimination stage threshold
t^{max} = threshold maximum
t^{min} = threshold minimum
t^{res} = response stage threshold

USAEC = U.S. Army Environmental Center
UXO = unexploded ordnance
YPG = U.S. Army Yuma Proving Ground

APPENDIX G. DISTRIBUTION LIST

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